

## ADJUSTABLE UNDERWIRE ASSEMBLY

### BACKGROUND OF THE INVENTION

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#### 1. Field of the Invention

The present invention relates to underwires used in supporting garments, particularly brassieres. In particular the invention relates to an adjustable underwire assembly which facilitates adjustments of the fit of the brassiere to accommodate minor changes in the user's size or activities, while promoting comfort to the user. The invention also relates to a brassiere incorporating such adjustable underwire assembly.

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#### 2. Description of Related Art

Brassieres are essential garments for most women. The purpose of a brassiere is to control excessive movement of the breasts which can cause discomfort, especially in larger breasted women. Without the proper support, the breasts will undergo stretching of soft tissue and ligaments, leading to general discomfort and ultimate sagging of the breast earlier than normal. Accordingly, a brassiere should not only fit properly to the wearer, but should also be comfortable to wear, while providing flexibility to accommodate changes in size or activities of the wearer.

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Larger breasted women generally require additional support which is generally provided by an underwire which is inserted into a sleeve extending along the underside of each cup of the brassiere. The underwire is usually in the form of a semi-rigid and resilient stiffening member of a generally arcuate U-shape which is inserted into the fabric pocket or sleeve that extends from the central portion of the brassiere and along the layer

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and outside portions of the breastcups to a position at or near the wearer's side, under each arm. The resilient underwire may be made of a metal such as steel, and will generally have a rectangular, oval or other cross-section, or it may be made from polymeric materials in a variety of cross-sectional shapes. They are generally provided with plastic comfort tips to avoid uncomfortable pinching and to minimize wear in the brassiere fabric. Still in other embodiments the underwire may be made of a metal coated with a polymeric material.

Commonly assigned U.S. Patent application no. 10/245,470, filed September 16, 2002 relates to a garment underwire with zones of differing flexibility. The disclosure of application no. 10/245,470 is incorporated herein by reference and made a part of this disclosure. Other efforts have been made to alleviate discomfort of such underwires as disclosed in U.S. patent nos. 5,830,040, 3,777,763 and 3,608,556, the disclosures of which are incorporated herein by reference and made a part of this disclosure.

While each underwire is made as an individual unit for separate insertion into an individual sleeves or pockets of adjacent breast cups, such underwires are generally fixed in the position which they assume by virtue of the location of the sleeve and their relative semi-stiffness. Their limited rigidity prevents adjustment of the shape or orientation to conform to the individual fit of the wearer.

Since it is generally understood that breast sizes and shapes will often vary from time to time with a woman's weight as well as her body chemistry, often a particular brassiere fitted with a one set of underwires will be adequate to the wearer over a particular period of time and the same brassiere will be inadequate during other periods of time when the breasts undergo changes in size and/or shape. For example, a woman's breast will assume a different size and shape during the menstrual cycle, as opposed to

the size and shape which it may assume during the remaining portion of the month.

Pregnancy will also affect breast size. In addition, the activity of the wearer will often vary and require different types of brassiere support. For example, a brassiere which is worn comfortably for employment activities may differ from a brassiere which is required  
5 by the same wearer with an evening dress or even when involved in other activities such as tennis, golf, swimming, ballet or gymnastics.

It will be readily understood that a single brassiere will often not accommodate such a relatively large number of activities and will therefore be adequate for one such activity, but inadequate for another. We have invented an adjustable underwire assembly  
10 for use in conjunction with a brassiere in which variations in size, shape and activated of the wearer can be accommodated with comfort as required during a given period of use.

## SUMMARY OF THE INVENTION

An adjustable underwire assembly for brassiere cups which comprises a first generally U-shaped arcuate underwire member dimensioned and is configured for insertion into a correspondingly generally U-shaped enclosure which extends along at least a portion of a first brassiere cup, a second generally U-shaped arcuate underwire member dimensioned and configured for insertion into a correspondingly generally U-shaped enclosure which extends along at least a portion of a second brassiere cup adjacent the first brassiere cup, and a device which connects the first generally arcuate member to the second generally arcuate member, the connecting device including means to selectively alter and maintain the relative angular orientation between the first and second generally arcuate members to facilitate adjustment of the brassiere cups as required by the wearer.

The connecting device preferably comprises a first elongated member attached to the first arcuate member and a second elongated material attached to the second arcuate member. The first and second elongated members are connected relative to each other by an adjustment device which permits adjustment of the angular relationship therebetween, the adjustment device further being capable of maintaining a selected angular position of the elongated members and the generally U-shaped arcuate underwire members.

The first elongated member is attached to the first generally U-shaped arcuate member and the second elongated member is attached to the second generally U-shaped arcuate member.

The adjustment device preferably comprises a generally circular member having a first plurality of radially inwardly extending teeth and a generally circular member at least partially positioned within the first circular member, the second member having a second plurality of radially outwardly extending teeth which mesh with the first plurality of teeth

to retain the relative angular orientation between the first and second underwire members. The first member is preferably an outer ring-like member and the second member is preferably an inner ring-like member positioned with the first ring-like member, the first and second ring-like members being relatively rotatable. The outer and inner ring-like members are rotatable relative to each other by providing rotative force to at least one of said members to cause said respective teeth to progressively engage and disengage each other during said rotation.

The first outer ring-like member preferably includes a generally radially extending relief groove at a pre-selected circumferential location between and adjacent selected inwardly extending teeth to permit flexing of the outer ring-like member and relative rotation of one of the ring-like members relative to the other. In one embodiment, the inwardly extending teeth extend over the entire inner periphery of the outer ring-like member, and the outwardly extending teeth extend over the entire outer periphery of the inner ring-like member.

In another embodiment, the inwardly extending teeth extend over a portion of the inner periphery of the outer ring-like member. In this embodiment, the outwardly extending teeth extend over a corresponding portion of the inner ring-like member, and the inwardly extending teeth preferably extend over a portion of the inner periphery of the outer ring at at least two locations. In another embodiment, the inwardly extending teeth extend over a portion of the inner periphery of the outer ring at three distinct locations spaced equally over the inner periphery of the outer ring.

In one embodiment, a pin extends transversely of the inner and outer rings and generally centrally thereof, the pin having a manually operable push-button at one end and a locking device at the opposite end. The locking device is adapted to engage certain of

the outwardly extending teeth of the inner ring to lock the inner ring in a pre-selected angular orientation relative to the outer ring, the locking pin is spring biased to the locked position and movable by manual actuation of the push button to a second position to release the teeth from the engaged position to permit relative rotation of the inner and  
5 outer ring-like members.

In another embodiment means is provided to maintain a predetermined relative angular orientation between the inner and outer ring-like members in the form of at least one elongated member fixedly attached to one of the ring-like members and positioned for releasable engagement with the outer ring-like member at selected locations thereon for  
10 maintaining a relative angular presentation between the outer and inner rings. The elongated member is preferably attached to the inner ring and adapted to releasably engage one of a plurality of indentations associated with the outer ring. In another preferred embodiment at least two of such elongated members are preferably attached to the inner ring and adapted to releasably engage one of a plurality of indentations  
15 associated with the outer ring.

In another embodiment the connecting device comprises at least two generally circular shaped members connected for relative rotation about a common axis, a first of the members including a plurality of teeth extending from one annular surface and the second of the members including a corresponding plurality of mating teeth facing the first  
20 plurality of teeth and extending from a corresponding facing annular surface. Means is provided to releasably separate the facing teeth to facilitate relative rotation of the members and corresponding adjustment of said underwires. In this embodiment, the means to permit adjustment of the underwires includes means to separate the annular

mating toothed surfaces to release the mating teeth from relative engagement with each other to permit rotation of one of the members relative to the other.

Locking means may be provided to assist in maintaining the relative angular orientation between the first and second generally circular shaped members, the locking means comprising at least one elongated member extending from one of the generally circular members toward the other, and a corresponding plurality of apertures correspondingly positioned on the other of the generally circular members. The plurality of apertures are located for reception of the at least one elongated member to assist in maintaining relative angular positions between the first and second generally circular members and the arcuate members.

At least two of such elongated members may provided for reception and removal with respect to at least two of said plurality of apertures in said other generally circular member. The connecting and adjustment device preferably comprises a first generally circular member and a second generally circular member positioned adjacent the first generally circular member, the members being rotatable about a common axis and having means to maintain a predetermined angular orientation between the two members. In this embodiment, the adjustable underwire assembly preferably includes means to maintain a predetermined relative angular orientation between the two members which comprises at least one elongated member extending from one of the members and a corresponding plurality of apertures in the other of the members. The elongated member is adapted to be releasably inserted into at least one of the apertures to maintain a predetermined relative angular orientation between the members.

At least of two of the elongated members are preferably provided on the first of the generally circular members and the elongated members are positioned for selective

reception and removal from at least two of the corresponding apertures and the other of the members. The adjustable underwire assembly further comprises means to separate the members to release the elongated members from the correspondingly aligned apertures on the of other the members. Preferably each of the elongated members comprises an  
5 elongated pin.

An adjustable device is disclosed for connecting a pair of U-shaped arcuate underwire members for a brassiere to facilitate relative rotation of said arcuate shaped underwire members to permit selective adjustment of the relative angular orientation thereof to predetermined positions selected by the wearer of the brassiere, which  
10 comprises a first generally circular member, a second generally circular member assembled with the first generally circular member, the generally circular members adapted for rotation relative to each other about a generally common axis, and means associated with the first member in the form of a plurality of generally pointed teeth facing toward a corresponding mating plurality of similarly dimensioned and configured  
15 teeth on the second member for selectively retaining the relative angular positions of the first and second members in a predetermined relation.

Broadly stated, the adjustment device includes breast supports comprising a first member and a second member, the first member being adapted to connect to a first underwire of a first breast support, the second member being adapted to connect to a  
20 second underwire of a second breast support. The first member and the second member are rotatably connected to selectively alter the relative angular positions of the first and second underwires. Means is provided to maintain the first and second members in pre-selected relative angular positions to maintain the first and second underwires in corresponding pre-selected angular positions relative to each other.



## BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will be described hereinbelow with reference to the drawings, wherein:

Fig. 1 is a partial front view of a brassiere incorporating an adjustable underwire assembly constructed in accordance with the invention, the wearer shown for environmental purposes;

Fig. 2 is a front view of an adjustable underwire assembly, illustrating the adjustable feature wherein one of the underwires is pivoted to an alternative open position for illustration purposes, as shown in phantom lines;

Fig. 3 is a front view of the adjustable underwire assembly of Fig. 2, adjusted to a position which brings the breasts in closer relation to each other to enhance cleavage;

Fig. 4 is an enlarged perspective view with parts separated for illustration purposes, of the connecting and adjustment device intended to selectively alter and maintain the relative angular orientation between the underwires to which the connecting device is attached;

Fig. 5 is a cross-sectional view taken along lines 5-5 of Fig. 1 of the connecting and adjustment device of the invention, with the underwires rotated upwardly out of position for illustration purposes only;

Fig. 6 is a partial cross-sectional view taken along lines 6-6 of Fig. 5;

Fig. 7 is plan view of an alternative embodiment of the connecting and adjustment device of Figs. 5 and 6, wherein the outer ring includes adjustment teeth in three selected spaced areas rather than over the entire inner circumference of the ring;

Fig. 8 is a perspective view from above, of an alternative embodiment of the connecting and adjustment device of the invention, incorporating a spring biased release

button and pin to engage and disengage the adjustment teeth to permit adjustment of the angular relation between the underwires;

Fig. 9 is a partial cross-sectional view taken along lines 9-9 of Fig. 8 with the underwires fixed in selected relative positions;

5 Fig. 10 is a cross-sectional view taken along lines 10-10 of Fig. 9;

Fig. 11 is a front view of the connecting and adjustment device of Fig. 10, with the connecting device in the release position and showing one of the underwires released and rotated to an alternative selected position;

10 Fig. 12 is a perspective view from above of another alternative embodiment of the connecting and adjustment device of the invention;

Fig. 13 is an enlarged view with parts separated for illustration purposes, of the embodiment of Fig. 12, illustrating the incorporation of a pair of pins which selectively engage depressions in the outer ring to assist in fixing the selected relative angular positions of the underwires;

15 Fig. 14 is a cross-sectional view taken along lines 14-14 of Fig. 12;

Fig. 15 is an enlarged perspective view with parts separated for illustration purposes, of still another alternative embodiment of the adjustment and connecting device of the invention, incorporating a spring biased release button in combination with a plurality of teeth upstanding from opposed faces of the adjustment rings;

20 Fig. 16 is a cross-sectional view of the connecting and adjustment device of Fig. 15 in the assembled condition;

Fig. 17 is a partial cross-sectional view taken along lines 17-17 of Fig. 16; and

Fig. 18 is a perspective view from above of another alternative embodiment of the connecting and adjustment device of Figs. 12-14, in which the ratcheting teeth have been eliminated and maintenance of the angular setting is accomplished only by the pins and apertures as shown.

## DETAILED DESCRIPTION OF THE INVENTION

Referring initially to Fig. 1 there is shown a partial front view of a woman wearing a brassiere 10 which incorporates the adjustable underwire assembly 12, shown in more detail in Figs. 2-4. In particular, adjustable underwire assembly 12 includes a pair of semi-rigid, but resilient arcuate underwires 14, 16, having plastic comfort tips 18, 20 attached at their free ends. The underwires 14, 16 are respectively inserted into correspondingly shaped arcuate pockets extending along the lower edge of each brassiere cup, and they are connected to each other by an adjustment device 22, the structure and function of which can best be described with reference to Fig. 4.

Referring now to Fig. 4, the connecting and adjustment device 22 is constructed of a plurality of components made of a suitable polymeric material such as nylon, high density polyethylene, low density polyethylene, polyvinyl chloride (PVC), monomers and/or copolymers. Other suitable materials such as metals or the like are contemplated.

Referring again to Fig. 4, connecting and adjustment device 22 includes generally circular shaped outer ring 24 having a plurality of radially inwardly extending teeth 26 projecting from the inner wall, and inner ring 28 having an axially extending section 30 which has a plurality of radially outwardly extending mating teeth 32 projecting therefrom. Inner and outer rings 28, 24 each include a generally elongated member - or arm - 34, 36 for attachment of a respective underwire 14, 16 either by molding techniques or other know methods of attachment. Locking pin 38 includes a disc shaped member 40 having a pair of legs 42, 44 having locking legs 46, 48 which snappingly engage with a circular shaped surface 50 formed on the inner ring 28 when the rings are assembled and the locking pin is inserted into the central opening 52 as best shown in Fig. 5. As shown in Fig. 4, outer ring 24 includes a radially extending relief opening 54

which permits flexibility of the ring to provide meshing flexibility and to accommodate meshing of the sets of teeth 26, 32 when the rings are assembled as shown in Figs. 5 and 6.

5 In operation, to adjust the relative angles of the underwires to the desired orientation, each underwire 14, 16 is rotated to the desired position by gripping and rotating either the underwires or the elongated arms 34, 36, causing the respective meshing sets of teeth 26, 32 to engage and ride over each other until the desired orientation of the underwires is achieved. At such point the respective teeth 26, 32 will remain in the last selected engaged position in the selected angular orientation. Thus the  
10 circumferential resistance force which will maintain the underwires in their selected positions will be provided by the sum total of the engaged inwardly extending teeth 26 and outwardly extending mating teeth 32.

Referring now to Fig. 7 there is illustrated an alternative embodiment of the outer ring 24. In this embodiment the radially inwardly extending teeth are located in three  
15 separate locations 26, rather than extending over the entire inner periphery of the ring 24. In this embodiment it is believed that the separate toothed sections 26 are sufficient to engage the teeth 32 of the inner ring 28 and to retain the underwires in the desired angular orientations. However in this embodiment, in view of the limited number of teeth 26, the possibility of misalignment of the teeth in engagement is reduced. Therefore  
20 the radial relief groove 54 of the embodiment of Fig. 4 has been eliminated.

Referring now to Figs. 8-11 there is illustrated an alternative embodiment 56 of the invention wherein inner ring 58 is provided with two separate outer wall sections 60, 62 having outwardly extending teeth 64, 66 and a locking mechanism which is provided

by pin 68 extending through outer ring 70 as shown. Pin 68 includes a push button 70 at one end and a biasing spring 74 between button 70 and the outer ring 70.

An arcuately shaped member 76 is provided at the opposite end of pin 68 on which locking teeth 78, 80 are provided to selectively engage locking teeth 64, 66 on the outer ring when the button 72 is released to permit the pin 68 and arcuate locking member 76 to move upwardly into locking engagement with teeth 64, 66 to assist in maintaining a selected relative angular orientation of the inner ring 58 and outer ring 70.

Rotation of elongated members - or arms - 34, 36 and respective underwires 14, 16 can be effected by pushing downwardly on button 72 to release the engagement of locking teeth 78, 80 and 64, 66. When the desired angular positions of both underwires is achieved, the pushbutton 72 is released and the locking teeth 76, 80 and 64, 66 are permitted to be engaged to lock the device and the underwires in position. As seen in Fig. 10, the entire assembly is secured together by locking member 82 which is formed of a disc-like member 84 having locking legs 86, 88 having arrowhead shaped locking tips 90, 92 at each end to engage a surface 94 formed as part of ring 58.

Referring now to Figs. 12-14, there is illustrated still another alternative embodiment of the connecting and adjustment device of the previous embodiments. In the embodiment shown, the connecting and adjusting device 100 includes outer ring 102 having radially inwardly extending locking teeth 104 and inner ring 106 having axially extending section 108 having radially outwardly extending teeth 110 configured and dimensioned to mesh with teeth 104 of outer ring 102. In most other respects the embodiment of Figs. 12-14 is identical to the embodiment of Figs. 4-7, with the additional feature provided by locking disc 110 having locking pins 112 which extend through apertures 114, 116 in inner ring 106 for selective engagement in indentations 118

provided on the front face of outer ring 102. Pin 120 includes pushbutton 122 at one end and is threadedly attached to disc 110, while locking device 124 having arrowhead-like locking legs 126, 128 retains the entire assembly together as shown in Fig. 14.

5 In operation, when push button 122 is depressed against spring 121 pins 112 are made to withdraw from indentations - or apertures - 118 to permit the inner ring 106 and outer ring 103 to be rotated relative to each other to adjust the relative positions of the underwires 14, 16. Thereafter, releasing the push button 122 permits the spring 121 to cause disc 110 and the tips of pins 112 to move axially toward outer ring 103 while pins 112 enter adjacent indentations - or apertures - 118 to provide additional rotational  
10 locking support for the rings and the underwires.

Referring now to Figs. 15-17 there is illustrated still another alternative embodiment 133 of the adjustment and connecting device of the invention wherein the inner and outer toothed rings of the previous embodiments are substituted by disc-like members 130, 132 having upstanding generally triangular teeth 134-136 upstanding from  
15 opposed facing surfaces as shown. The assembly is held together by a fastener 138 having a disc-shaped pushbutton 140 attached to threaded shaft 146 which is threadedly attached to end disc 142 and biased axially away from the assembly by coil spring 144.

In operation, disc-like pushbutton 140 is depressed to release the engagement of the toothed surfaces 130, 132 to permit adjustment of the positions of the elongated arms  
20 34, 36 and respective underwires 14, 16. Thereafter, the push button 140 is released to lock the positions of the underwires in the desired locations.

It should be noted that in the embodiments shown, the mating teeth shown have equally dimensioned upstanding sides, or they have generally isosceles triangular cross-sectional configurations. However, it is also contemplated to modify these embodiments

by providing alternative configurations for the mating engaging teeth. For example, in some instances the upstanding engaging teeth or members can have a right triangular cross-sectional shape. With such right triangular engaging members, particularly in the embodiments of Figs. 12-17, the relative angular positions of the elongated arms 34, 36 and respective underwires 14, 16 will be positively locked in one direction, while releasing the teeth can only be accomplished through the pushbutton release mechanism shown in these embodiments. By right triangular configuration is meant that one of the angles of the triangle is 90 degrees while the hypotenuses of each of the mating teeth pass over each other when adjustment of the positions of the underwires is made.

Referring to Fig. 18 there is shown still another alternative embodiment 150 of the connecting and adjustment device of Fig. 13, wherein the ratcheting teeth have been eliminated and adjustment of the relative angular positions of outer ring 152 and inner ring 154 is accomplished only by axially extending pins 156, 158 which are positioned and dimensioned to releaseably enter indentations (or apertures) 160 in the same manner as described in connection with the embodiment of Figs. 12-14. Pin 162 biases disc 168 towards disc 169, and thereby also biases pins 156, 158 into apertures 160 by spring 164. Pin 162 is threaded into threaded aperture 166 in disc 168. Arrowhead shaped locking legs 170, 172 are also identical to the legs 126, 128 shown in Figs. 12-14 and serve to retain the entire assembly together in the manner shown in Fig. 14.

It should also be understood that although pluralities of mating engaging teeth are disclosed, any engaging surfaces are contemplated to achieve locking of the members. For example, roughened surfaces can be provided to engage each other, or even knurled-type surfaces can be provided to prevent relative rotation between the members.